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AGRICULTURAL MEMORANDUM NO. 639

Dates of Return to Field Capacity in the East of Scotland

by W G Harper

Enquiries are frequently received for meteorological information relating to the return of the soil to field capacity, often the main limitation in autumn farming operations. Estimates of excess winter rainfall and excess spring rainfall for 16 stations in the East of Scotland were given in Agricultural Memorandum No. 636, covering the 20 years 1954-73, and the dates of return to field capacity derived from those calculations are examined in this paper. A few stations with shorter periods of record or non-standard periods were included in order to improve the coverage, and Berwick-on-Tweed in Northumberland has been included because of the relevance of its records to the southeastern part of Berwickshire.

2. The model adopted for extraction of soil moisture was described in Agricultural Memorandum No. 636[1], and was that used in MAFF Technical Bulletin No. 24 for England and Wales[2], in which the validity of estimates of soil moisture deficit is discussed in some detail.

3. In Table 1 are given the mean dates of return to field capacity for the 16 stations. They are given in ranking order of mean date of return, and these show quite a high correlation (0.94) with annual rainfall (R). Annual rainfall averages for the period 1916-50 were chosen for this comparison because they are widely available for the whole of Scotland in the form of published rainfall maps. The overall range of mean dates of return is from 6 December at Dunbar in East Lothian (R 595 mm) to 10 September at Blyth Bridge in Peeblesshire (R 915 mm). There are upland areas of East Scotland with substantially higher rainfall than Blyth Bridge but there were no stations in them with adequate records. Quartile values for each station are included in Table 1, e.g. at Dunbar 25 per cent of the dates of return were in or before early November i.e. 5 years in 20, and 25 per cent were in or after early January.

4. Table 2 gives the extreme dates of return to field capacity at each station. At the one extreme, at Blyth Bridge in 1 year in 17 and at Marchmont in 1 year in 20, rainfall exceeded potential evapotranspiration in every month and no soil moisture deficit developed. (For the purpose of deriving a mean value the date of return for these years was taken to be 1 April). At the other extreme a deficit of soil moisture persisted throughout the entire winter of 1972/73 at Dunbar, Haddington, Turnhouse, Arbroath and Berwick-on-Tweed. (These were given nominal dates of return of 31 March in the following year). It will be noticed that at every station at which the standard 20-year period of record was available the latest date of return was in 1972/73, while 1958 produced the earliest dates of return over much of the area.

5. In Table 3 the computed dates of return are given for each year for the 11 stations with complete records for 1954-73.

6. Estimation of dates of return to field capacity

Estimates of mean date of return to field capacity and of upper and lower quartiles can be obtained from Fig 1 for any station given its annual rainfall average. Approximate extreme dates of return are also given. Alternatively values may be calculated from the following regression equations.

				Correlation with R
Mean date of return	M	=	369 - 0.231 R	-0.94
Upper quartile	B	=	329 - 0.224 R	-0.79
Lower quartile	A	=	368 - 0.178 R	-0.87

where R is in millimetres and M, B and A are given as day numbers with 1 April = 1, 1 May = 31, 1 June = 61, etc. For simplicity each month has been assumed to have 30 days.

7. Comments or suggestions concerning this paper would be welcomed by the author.

References

1. "Excess Winter Rainfall in the East of Scotland", W G Harper, Agricultural Memorandum No. 636, 1974.

2. "The Significance of Winter Rainfall over Farmland in England and Wales", Technical Bulletin No. 24, Ministry of Agriculture, Fisheries and Food, 1971.

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4 March 1975

Table 1. Dates of Return to Field Capacity - Means and Quartiles

County	Station (1)	Mean	Quartiles		R mm (2)	Period (3)	Grid Ref	Ht. m
(a) 20-years data 1954-73								
East Lothian	Dunbar	Dec 6	Early Nov	Early Jan	595		NT 6779	23
Angus	Arbroath	Nov 21	Late Oct	Mid Dec	670		NO 6541	29
Northumberland	Berwick-on-Tweed	Nov 14	Late Sep	Mid Dec	590		NU 0053	21
Fife	Leuchars	Nov 5	Early Oct	Late Dec	680		NO 4721	10
Midlothian	Turnhouse	Oct 27	Mid Sep	Early Dec	685		NT 1674	35
Perthshire	Mylnefield	Oct 12	Early Sep	Late Nov	715		NO 3430	30
"	Perth	Oct 7	Late Aug	Late Nov	780		NO 1024	23
Fife	Kirkcaldy	Oct 5	Late Aug	Mid Nov	755		NT 2791	32
Berwickshire	Marchmont	Oct 1	Late Aug	Mid Nov	780		NT 7448	152
Midlothian	Bush	Sep 19	Early Aug	Early Nov	905		NT 2464	184
Roxburgh	Sourhope	Sep 17	Early Aug	Late Oct	880		NT 8520	221
(b) Stations with limited data or non-standard period								
East Lothian	Haddington	Nov 6	Early Sep	Late Nov	650	56-73	NT 5174	49
Angus	Montrose	Nov 2	Late Oct	Mid Nov	685	34-53	NO 7162	5
"	Carnoustie	Oct 28	Early Oct	Early Dec	740	52-71	NO 5624	9
Perthshire	Blairgowrie	Oct 9	Early Sep	Mid Nov	760	61-73	NO 1744	70
Peebles	Blyth Bridge	Sep 10	Mid Aug	Early Nov	915	57-73	NT 1446	253

Notes:- (1) Stations listed in order of mean date of return to field capacity.
(2) Rainfall average 1916-50 (except Sourhope which is for 1954-73).
(3) Period of records used if differing from 1954-73.

Table 2. Extreme Dates of Return to Field Capacity

Earliest Return			R mm	Latest Return			R mm
(a) 20-years data 1954-73							
Late Aug	1963	Berwick-on-Tweed	590	Did not return	1972/3	Dunbar	595
Mid Aug	1966	Dunbar	595	" " "	1972/3	Berwick-on-Tweed	590
Early Aug	1958	Arbroath	670	" " "	1972/3	Arbroath	670
" "	1958	Leuchars	680	" " "	1972/3	Turnhouse	685
Mid Jul	1958	Sourhope	880	Late Jan	1973	Mylnefield	715
Farly Jul	1958	Turnhouse	685	Mid Jan	1973	Leuchars	680
" "	1958	Mylnefield	715	" "	1973	Kirkcaldy	755
" "	1958	Kirkcaldy	755	" "	1973	Marchmont	780
" "	1958	Perth	780	Late Dec	1972, 1973	Perth	780
Early Jun	1958	Bush	905	" "	1972	Bush	905
No deficit	1958	Marchmont	780	Early Dec	1972	Sourhope	880
(b) Stations with limited data or non-standard period							
Mid Aug	1963	Blairgowrie	760	Did not return	1972/3	Haddington	650
Early Aug	1937	Montrose	685	Mid Jan	1965	Carnoustie	740
Late Jul	1958	Haddington	650	Early Jan	1937	Montrose	685
" "	1958	Carnoustie	740	Early Dec	1972	Blairgowrie	760
No deficit	1965	Blyth Bridge	915	" "	1972	Blyth Bridge	915

Table 3. Dates of Return to Field Capacity 1954-73 - East of Scotland

Station	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Arbroath	Oct 21	Dec 20	Sep 19	Dec 17	Aug 5	Dec 4	Oct 26	Dec 4	Nov 10	Aug 19	Mar 7	Oct 27	Aug 20	Nov 9	Oct 26	Dec 19	Nov 28	Jan 18	Y	Jan 28
Berwick-on-Tweed	Oct 3	Dec 28	Sep 8	Dec 13	Aug 29	Dec 11	Oct 15	Nov 29	Sep 29	Aug 22	Jan 7	Sep 17	Aug 29	Nov 17	Oct 27	Dec 5	Dec 6	Jan 13	Y	Jan 21
Bush House	Aug 9	Dec 17	Aug 4	Jul 29	Jun 8	Nov 14	Oct 8	Sep 25	Aug 14	Aug 8	Oct 19	Jul 5	Aug 6	Oct 11	Jul 22	Nov 13	Oct 11	Oct 15	Dec 22	Dec 3
Dunbar	Oct 18	Jan 28	Sep 12	Dec 24	Dec 5	Dec 9	Nov 22	Dec 7	Dec 3	Sep 1	Jan 24	Nov 4	Aug 20	Dec 3	Nov 6	Jan 4	Nov 26	Jan 15	Y	Y
Kirkcaldy	Sep 6	Dec 17	Aug 1	Aug 10	Jul 7	Nov 18	Oct 12	Sep 19	Aug 30	Aug 22	Sep 27	Sep 6	Aug 22	Oct 10	Oct 7	Nov 27	Oct 1	Nov 20	Jan 11	Dec 30
Leuchars	Oct 15	Dec 22	Aug 30	Dec 1	Aug 6	Nov 27	Oct 11	Oct 23	Nov 6	Aug 26	Jan 3	Oct 2	Aug 19	Nov 8	Oct 15	Dec 26	Nov 10	Jan 2	Jan 20	Jan 10
Marchmont	Aug 6	Dec 14	Aug 11	Aug 30	X	Nov 20	Oct 10	Oct 26	Sep 11	Aug 8	Oct 21	Sep 6	Aug 13	Oct 7	Sep 15	Nov 8	Nov 7	Nov 24	Jan 20	Dec 10
Mylnefield	Aug 24	Dec 16	Sep 9	Aug 29	Jul 7	Nov 20	Oct 3	Sep 23	Sep 16	Aug 23	Nov 24	Sep 17	Aug 27	Nov 2	Oct 11	Dec 4	Sep 8	Nov 13	Jan 21	Dec 28
Perth	Aug 16	Dec 8	Aug 25	Aug 23	Jul 10	Nov 16	Sep 3	Oct 1	Sep 19	Aug 17	Nov 22	Sep 10	Sep 6	Oct 17	Oct 11	Dec 6	Sep 3	Nov 25	Dec 23	Dec 26
Sourhope	Aug 4	Nov 24	Aug 8	Aug 13	Jul 11	Nov 15	Sep 4	Oct 16	Sep 2	Aug 8	Oct 19	Jul 15	Aug 4	Sep 26	Jul 16	Nov 8	Oct 3	Nov 13	Dec 10	Oct 9
Turnhouse	Aug 18	Jan 6	Aug 18	Dec 1	Jul 8	Nov 22	Nov 15	Oct 26	Sep 24	Sep 20	Dec 2	Sep 3	Aug 8	Oct 17	Oct 6	Nov 22	Nov 5	Dec 11	Y	Dec 29
Area Mean	Sep 7	Dec 21	Aug 24	Oct 9	Jul 20	Nov 24	Oct 12	Oct 24	Sep 29	Aug 21	Dec 2	Sep 10	Aug 19	Oct 25	Sep 28	Dec 2	Oct 23	Dec 7	Feb 6	Jan 1

KEY:- X = No soil moisture deficit. Y = Did not return to field capacity.

Return dates in January, February and March refer to the following year.

E.R.

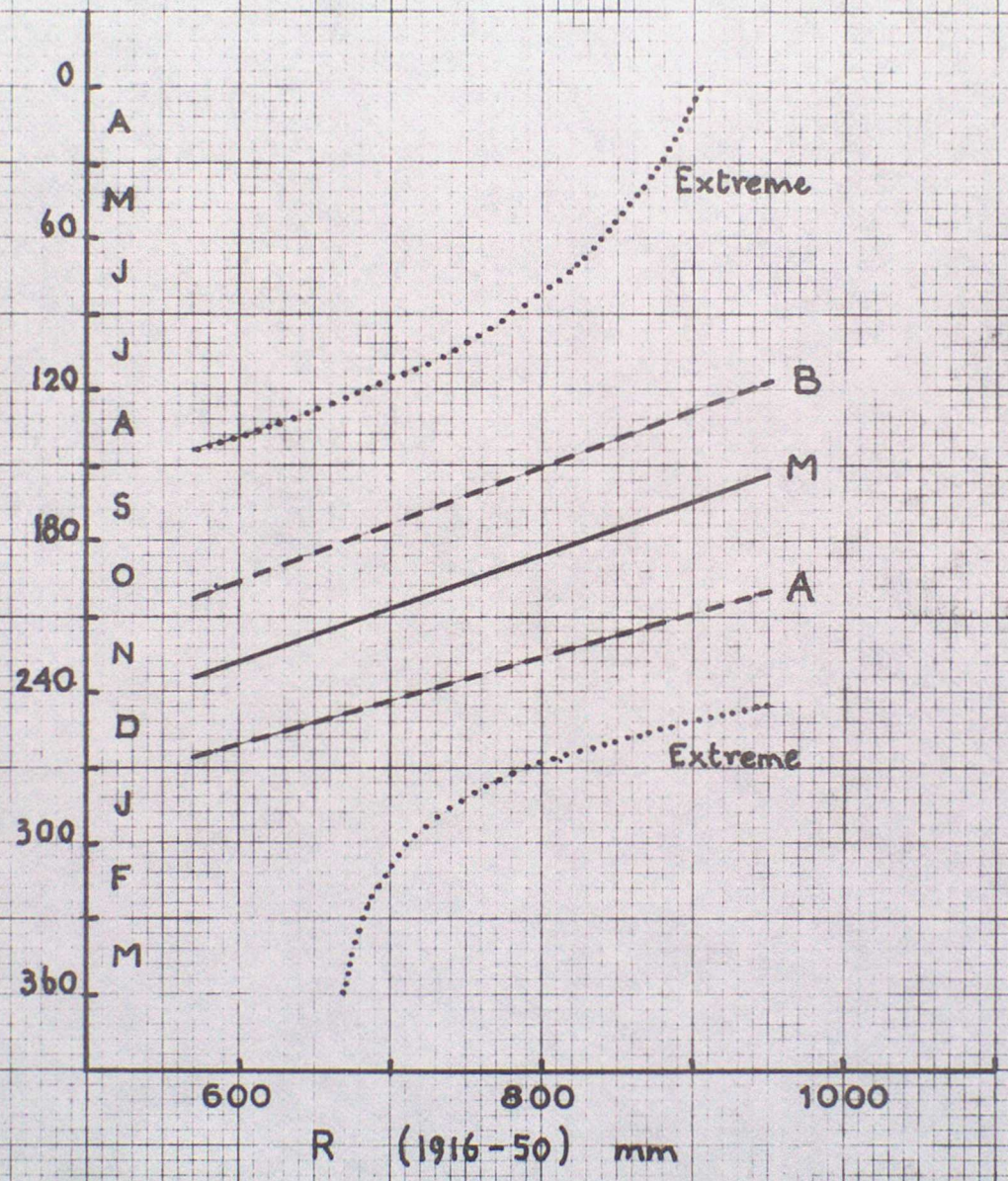

Fig 1. Dates of return to field capacity related to annual average rainfall